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TISSUE GLYCOGEN OF *MYLABRIS PUSTULATA* THUNB. AND *PERIPLANETA AMERICANA* L. (INSECTA)

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Abstract.—The glycogen contents in the fat bodies, thoracic muscles, foregut, midgut, hindgut, ovaries and testes of *Mylabris pustulata* and *Periplaneta americana* have been studied. In *M. pustulata,* the major depot of glycogen contents (3.42 mg/g) has been noted in the fat bodies, while it is not so in *P. americana.* The midgut of both insects under investigation shows a higher level of glycogen than the rest of the tissues except fat bodies. In *M. pustulata,* the glycogen contents of ovaries are at a higher level than that of testes. In *P. americana,* the glycogen reserves are comparatively higher in ovaries and thoracic muscles than *M. pustulata.* The glycogen contents. It is known that insects contain digestive amylase in the midgut ferences ($P > 0.05$) while the rest of the tissues contain significantly different contents ($P < 0.05$).

Introduction

Glycogen, an important carbohydrate reserve in insects, is the first source of energy to be utilized under stress of starvation (Strauss 1911; Hill and Goldsworthy 1970). Most of the information with regard to the glycogen reserves in insects, available until recently, deals with its estimations from the whole body extracts; which of course does not provide any clue regarding the capacity of different tissues to retain and synthesize this compound. Moreover, work on individual tissues permits an insect biochemist to compare his results with the mammalian tissues where experimentation is not done on the whole body extracts. The distribution of glycogen in the tissues of insects has been studied in the past only by a few workers like Yeager and Munson (1941) in insect muscles, Wigglesworth (1949) in abdominal fat body and Nemec (1977) in the ovaries. The study in hand deals with the glycogen estimations from the different tissues of *Mylabris pustulata* and *Periplaneta americana,* and clearly, the aim is to elaborate this field so that in the long run some general and coherent trend in this respect can be deduced.

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Table 1. Distribution of glycogen in different tissues of *Mylabris pustulata* and *Periplaneta americana.*

Tissues	mg glycogen ± SD/g wet tissue weight†	
	M. pustulata	*P. americana*
Foregut	1.51 ± 0.032**	1.56 ± 0.016**
Midgut	3.17 ± 0.110**	2.43 ± 0.123**
Hindgut	1.49 ± 0.036	1.16 ± 0
Ovaries	0.781 ± 0.004*	1.46 ± 0.024
Testes	0.660 ± 0	—
Fat bodies	3.42 ± 0.012	2.12 ± 0.008
Thoracic muscles	1.02 ± 0	1.67 ± 0.018

† Each value mentioned in the table is at least an average of five determinations. SD denotes standard deviation. *P* values have been calculated by applying Student's *t*-test of significance.
* $P < 0.05$.
** $P < 0.01$.

Materials and Methods

Mature adults of *Mylabris pustulata* were collected from kitchen gardens, and of *Periplaneta americana* from places such as kitchens and storerooms etc. from the Campus of Punjabi University, Patiala, India. Both the insects were dissected under physiological saline to obtain tissue samples from their respective foregut, midgut, hindgut, ovaries, testes, fat bodies and thoracic muscles. The samples taken were weighed and digested independently in 30% KOH for the extraction of glycogen. For extraction, the method of Heatly (1935) was employed while the estimation of glycogen was made colorimetrically according to Montgomery (1957).

Results and Discussion

The results of estimations of glycogen from different tissues of *M. pustulata* and *P. americana* are listed in Table 1.

In *M. pustulata,* the maximum glycogen contents have been recorded in the fat bodies, which indicates that this tissue is the major storage site for this energy reserve. This finding is in accordance with the observations of Kilby (1963), Gilmour (1965) and Wyatt (1967). However, in *P. americana,* the fat body glycogen, though quite high is little less than that of its depot in midgut.

The midgut of both the insects under study is quite rich in glycogen contents. It is known that insects contain digestive amylase in the midgut which hydrolyses dietary starch and glycogen and hence the absorption of digested food material takes place in this region. Treherne (1958) in *Periplaneta* and *Schistocerca* has observed that the absorption of glucose is largely confined to the midgut caeca. Thus the presence of a somewhat high concentration of glycogen in the midgut of both the insects suggests that a portion of the glucose after absorption gets converted into glycogen in this region of the alimentary canal. Wigglesworth (1949) in *Drosophila* and Mayer and Candy (1969) in *Locusta* have also observed that the midgut cells themselves are known to contain glycogen stores or it can be said that the glycogen anabolism takes place in the midgut cells. This is perhaps because the midgut converts surplus glucose into glycogen which is not readily utilized by the insect body.

In *M. pustulata,* the glycogen contents of ovaries are at a higher level than that of testes (Table 1). This is perhaps because of the necessity of this carbohydrate for vitellogenesis and for the formation of glycosaminoglycans present in the vitelline membrane and the chorion (Rockstein 1978). The glycogen which also serves as the principal carbohydrate in yolk, is usually synthesized in the ovary from glucose and trehalose derived from the fat body and the hemolymph. Similarly, the ovaries of *P. americana* also contain high concentration of glycogen contents. Moreover, it is known that the glycogen is also synthesized in the ovaries during the terminal phase of vitellogenesis (Rockstein 1978).

A comparison between the glycogen contents of foregut of *M. pustulata* and *P. americana* shows no significant difference ($P > 0.05$). Generally the foregut of insects is not involved in the absorption of glucose, but in *Periplaneta,* the crop has been found to have little importance in the absorption of glucose (Eisner 1955). According to above mentioned author, some lipase activity exists in the crop of *Periplaneta* as the result of transfer of secretions from the midgut into the foregut. So the presence of newly formed fatty acids facilitate a little absorption of glucose through the crop cuticle. Thus, the presence of more glycogen contents in the foregut of *P. americana* confirms that some absorption also takes place in the crop region of the foregut. As the foregut of *M. pustulata* shows no significant difference in this energy reserve from that of *P. americana,* it can be suggested that the foregut region of *Mylabris* too might be involved in the absorption of glucose like that of *Periplaneta.*

The glycogen contents of thoracic muscles of *P. americana* are significantly higher than that of *M. pustulata* ($P < 0.05$). It has been already reported that *P. americana* uses carbohydrate as the major source of energy for flight (Polacek and Kubista 1960) and the glycogen reserves of thoracic musculature comprise the major source of the utilized substrate (Downer and Matthews 1976). So the presence of more glycogen in the thoracic muscles of *P. americana* shows that it is more efficient in using this reserve than *M. pustulata.*

By comparing the glycogen contents of the two insects, it is evident that there exists significant variation with respect to midgut, hindgut, ovaries, fat bodies and thoracic muscles ($P < 0.05$) revealing a species specific distinctness in the metabolism of this compound in these tissues. At 1% level of significance, there is no difference in the glycogen reserves of foregut, midgut and hindgut. Although at 5% level of significance, foregut is the only tissue in the two insects where there exists no variation.

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